

ORIGINAL ARTICLES

## Burden and Causes of Death Among Children Under Five: Analysis of Death Registration Data from the Community in Lao Cai Province 2022–2023

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### ABSTRACT

**Objectives:** The study reports mortality prevalence and causes of death amongst children under five in Lao Cai province during 2022–2023 from community death registration system.

**Methods:** Data were collected from routine death registration systems, named A6/YTCS, in Lao Cai province. The study analysed and reported the distribution of mortality rates by age, geographic and gender and causes of deaths.

**Results:** Death registration reports 385 deaths of children under 5 in Lao Cai province during the study period. Numbers of neonatal deaths were the highest, account for 32,6% according to A6/YTCS and 35,3% by other sources. Numbers of deaths in boys are higher than girls. Findings showed that preterm birth, pneumonia, and drowning, accounting for 24%, 22%, and 10% of total child deaths in Lao Cai, respectively.

**Conclusions:** Preterm mortality and drowning are the leading causes of death for children in Lao Cai province. We recommend further assessments the cause of death using community-based data to boost the intervention measure for neonatal health care in Lao Cai.

**Keywords:** Mortality, children, Lao Cai, cause of death, neonatal death.

### INTRODUCTION

According to statistics from the United Nations International Children’s Emergency Fund (UNICEF), the under-five mortality rate (U5MR) in Vietnam has experienced a significant decline, decreasing from 51.6 per 1,000 live births in 1990 to 24 per 1,000 in 2007 and further reduction to 20.3 per 1,000 live births in 2022 (1). Hospital data indicates that neonatal conditions are the

leading fatal causes of mortality in children, accounting for approximately 70% of the total of deaths (2, 3). Additionally, child mortality prevalences vary across different geographic regions (4–6), ethnic groups (4), and individual factors (e.g gender) (4–6), economic status (7), parental education level (4, 5), and family size (4). For instance, the U5MR is higher in the Northern Midlands and Mountainous Region in comparison to the Red River Delta and the



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Mekong River Delta (8, 9). Furthermore, The U5MR among ethnic minorities in the northern mountainous areas is approximately 3.5 times higher than that of the Kinh ethnic group (10).

At present, mortality data in Vietnam are documented across various systems, both from hospital and community base. However, discrepancies in case counts among these systems and inadequacies in the reporting of causes of death persist. Hospital-based studies indicate that neonatal/perinatal conditions, respiratory diseases, and congenital disorders (2, 11, 12) are the leading causes of death amongst Vietnamese children. Among neonates, the most common causes include preterm birth, birth asphyxia, respiratory distress, and infections (2, 3, 13, 14). On the other hand, research from community side reports that drowning, injuries, and poisoning are predominant causes of deaths in U5MR (15, 16). Nonetheless, several studies emphasised that the majority (77.9%) of deaths across all age groups occurred outside healthcare facilities (15). The finding highlights the need for community-based research to better understand population-wide mortality patterns, including children under five.

In this study, we collected death data from death registration system in Lao Cai province (book A6/YTCS) in order to analyse the cause of death distribution in children under five years old in Lao Cai province, a mountainous area in northern Vietnam. The study aims to explore child mortality patterns in the province, serving as a basis for policy recommendations to strengthen child health interventions and reduce U5MR.

## METHODS

**Study Design:** This study employs a cross-sectional design.

**Study site and time:** The study was conducted in Lao Cai province from December 2023 to December 2024.

**Sample size and sampling method:** This study gathered comprehensive information on all deaths among children under five years of age from January 1, 2022, to December 31, 2023, in Lao Cai province, from mortality reporting system (called A6/YTCS book).

The A6/YTCS registered documents all deaths under the Health Commune Center of the respective commune or ward from population collaborations, veterans and the elderly. The data are compiled quarterly and apply to all commune and ward health stations. In Lao Cai, to prevent the missing of neonatal deaths, cases of live-born infants who died shortly after birth must be recorded both in the birth register (A4/YTCS) but also in the A6/YTCS register.

**Research variables and Indicators:** The study extracted all data from A6/YTCS book, including age, sex, date of birth, date of death, cause of death, ethnicity, and residential address. Research team from Provincial Health Department in Lao Cai are responsible for data extraction and cross-check with Provincial Justice. All individual data, then, send to research team in Vietnam National children Hospital for cleaning and analysis.

**Processing and analyzing data:** Cause of deaths were aggregated and standardized for each record by paediatric physician from Vietnam National Children's Hospital. Age group was categorized in to <29 days; 29 days – <1 year and 1–4 years) from age variable. We also added the season variable based on month of deaths. The rainy season extends from April to September, while the dry season spans from October to March of the following year. Data cleaning and analysis were conducted using Microsoft Excel. Since no available data of children live birth in Lao Cai, our study reports death distributions and cause of deaths by absolute numbers.

**Research ethics:** Personal information of patients was used solely for research

purposes. The study was approved by the Ethics Committee of the National Children’s Hospital under decision number 3342/BVNTW-HDDD on December 29<sup>th</sup> 2023.

## RESULTS

### Prevalence of deaths

During 2022–2023, 385 deaths in the A6/YTCS

registry in Lao Cai province were collected (Table 1). The mortality proportion of male and female children is not significant different, approximately 45% and 55% respectively. The mortality proportion in the neonatal group (under 29 days) accounts for the majority of deaths, representing 35% of the total cases for two years. The number of recorded deaths in Bac Ha and Bat Xat are higher than in other localities, both are 13,8% total of deaths.

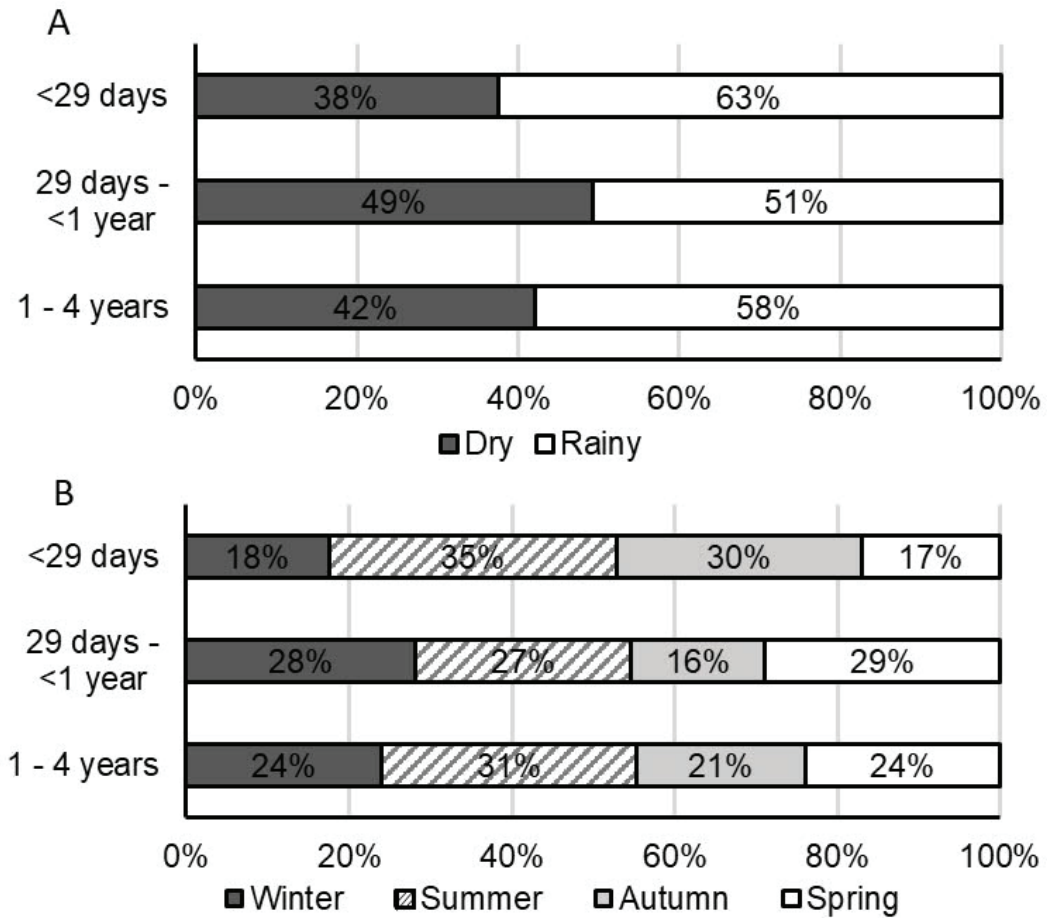
**Table 1. Number of deaths by sex, age, and place of residence, Lao cai 2022-2023**

	<b>2022</b> <i>(n=203)</i>	<b>2023</b> <i>(n=181)</i>	<b>Total</b> <i>(n=385)</i>
<b>Gender</b>			
Female	102 (50%)	71 (39%)	173 (45%)
Male	101 (50%)	111 (61%)	212 (55%)
<b>Age group</b>			
<29 days	70 (34%)	66 (36%)	136 (35%)
29 days - <1 year	73 (36%)	55 (30%)	128 (33%)
1 - 4 years	60 (30%)	61 (34%)	121 (31%)
<b>District</b>			
Bac Ha	32 (16%)	21 (12%)	53 (14%)
Bao Thang	20 (10%)	23 (13%)	43 (11%)
Bao Yen	24 (12%)	16 (9%)	40 (10%)
Bat Xat	29 (14%)	24 (13%)	53 (14%)
Muong Khuong	23 (11%)	25 (14%)	48 (12%)
Si Ma Cai	18 (9%)	15 (8%)	33 (9%)
Van Ban	28 (14%)	13 (7%)	41 (11%)
Lao Cai (city)	7 (3%)	8 (4%)	15 (4%)
Sa Pa	22 (11%)	37 (20%)	59 (15%)

The study observed the number of deaths in 2022 was higher than in 2023. This pattern was indicated significantly in Bac Ha and Van

Ban. On contrast, number of deaths in Sapa in 2023 is higher than in 2022.

### *By age groups*

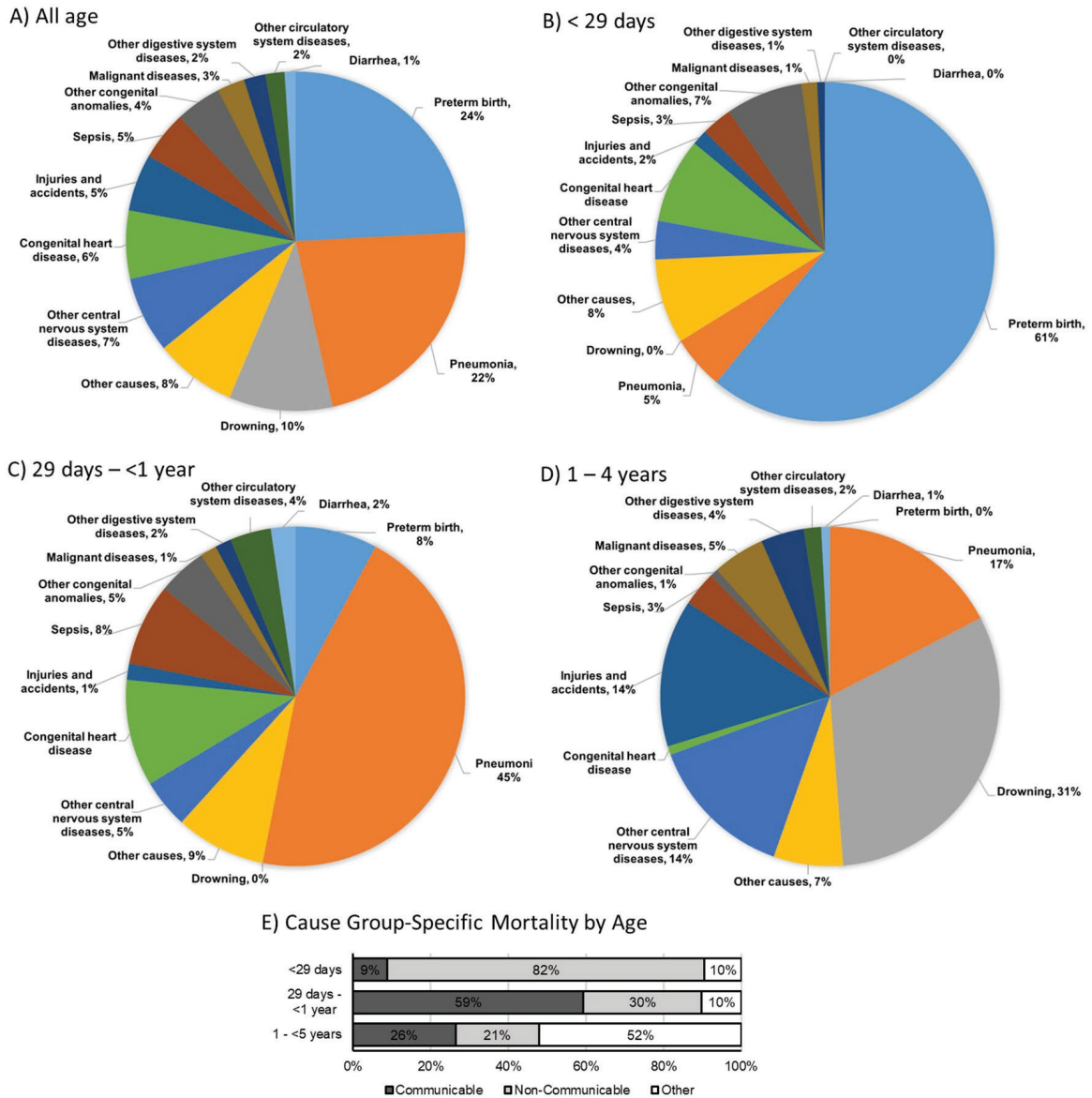


**Figure 1. Total mortality percentage among children by age group and seasons**

The number of deaths primarily occurs during the rainy season, particularly among age group under neonatal death. Number of deaths in winter is likely higher than other reasons in age group from 29 days to under one years. For children from 1-4 year-old, number of death during summer season might higher than other seasons, but not much significant (figure 1)

**By cause of death**

Drowning accounted for 10% of cases, while other injuries caused 5% of deaths (Figure 2A) in Lao Cai in two years. Among neonates (under 29 days old), the majority of deaths (61%) were due to preterm birth, then, pneumonia accounted for only 5% (Figure 2B). In children aged 29 days to under 1 year, pneumonia was the leading cause of death (45%, Figure 2C). For children older than 1 year, drowning was the most common cause (31%), whereas pneumonia accounted for only 17% in this age group (Figure 2D).

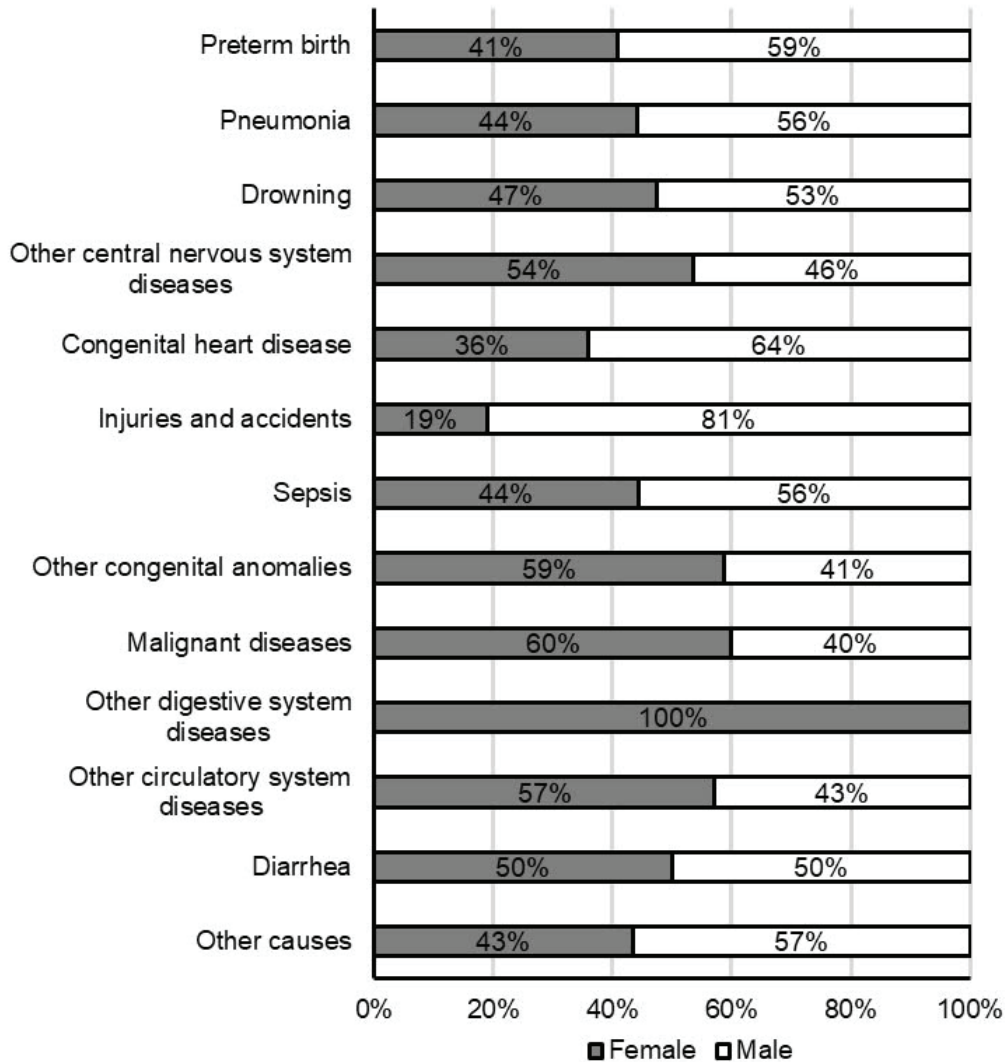


**Figure 2. Distribution of causes of death among children**

**(A) all age, (B) under 29 days, (C) 29 days – under 1 year, (D) 1 – 4 years, and (E) by cause group by age in Lao Cai Province, during 2022–2023**

Distinct patterns in mortality distribution across three major cause categories – infectious diseases, non-communicable diseases, and other causes – were also observed (Figure 2E). The proportion of deaths due to non-communicable diseases decreased with age, accounting for 82% (111 cases) of neonatal (<29 days) deaths but only 21% (26 cases) among children aged 1–4

years over the two-year period (Figure 2E). In contrast, the proportion of deaths from other causes, including injuries, increased with age. Additionally, communicable diseases accounted for the highest proportion of deaths within the 29-day to <1-year age group, making up 59% (76 cases) of all deaths in this age group. Detailed proportion death by gender was presented in Figure 3.



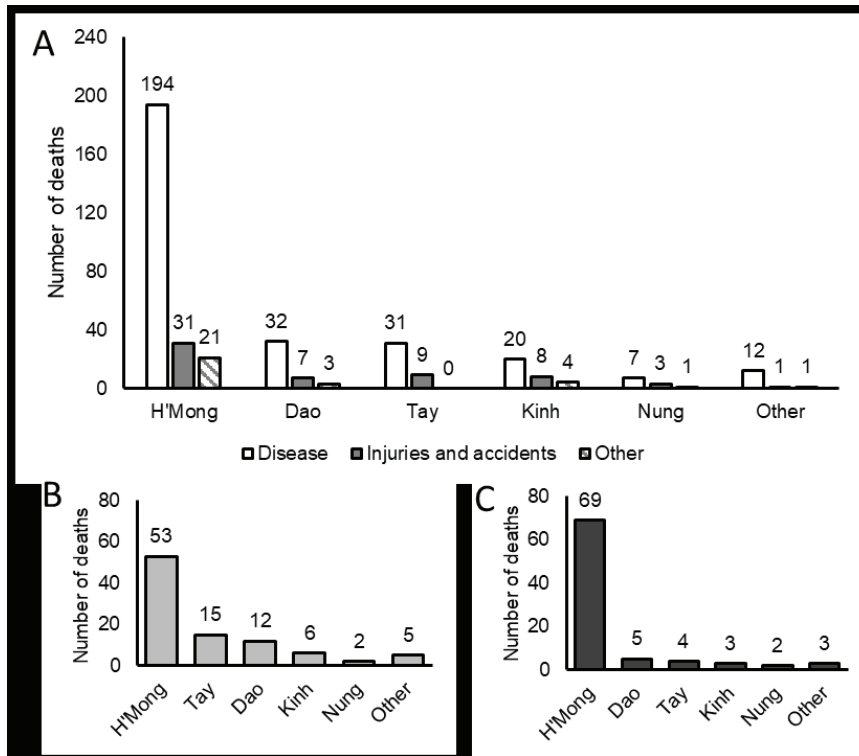
**Figure 3. Distribution of under-five mortality causes (A) by sex and (B) by season in Lao Cai province, 2022–2023**

Child mortality tends to increase during the rainy season compared to the dry season across most cause-of-death categories (Figure 3B). Specifically, mortality due to 10 out of 13 cause groups was higher in the rainy season than in the dry season. This pattern is particularly evident for common causes such as preterm birth, pneumonia, and drowning.

**By ethnicity**

Mortality distribution also varied by ethnicity (Figure 4A). Notably, H’Mong children

exhibited the highest mortality, accounting for 64% of total cases. As seen in the finding from analysing for preterm birth and pneumonia. The highest burden of preterm birth-related deaths was also observed among H’Mong children (53 cases), whereas the corresponding number in other ethnic groups did not exceed 15 cases (Figure 4B). A similar trend was seen for pneumonia-related mortality, which was most prevalent among H’Mong children (69 cases), while deaths in other ethnic groups ranged from 2 to 5 cases (Figure 4C).



**Figure 4. Number of deaths by cause across ethnic groups:**

**(A) overall causes, (B) preterm birth, and (C) pneumonia, during 2022–2023 in Lao Cai Province**

## DISCUSSION

This study collected, analyzed and compared child mortality data from A6/YTCS mortality register. According to Circular 27-2014-TT-BYT, the A6/YTCS registered documents all deaths under collaborations systems in community. In Lao Cai, cases of live-born infants were recorded both in the birth register (A4/YTCS) but also in the A6/YTCS register. Therefore, the A6/YTCS register serves as the most important data source providing mortality information categorized by age, sex, and cause of death from community. On the other hand, Certificate of Death- an official document issued by the Vietnamese government to confirm an individual’s death as registered. As per Circular 04/2020/TT-BTP of the Ministry of Justice, the required information includes the exact time of death (down to the hour

and minute), place of death (health facility name or address at the commune level), and cause of death. The document was issued by Commune Justice Division (called Death Registration Systems-DRS). In this study, we also obtained and analysis the list of all deaths cases from Death certification registration to compare the coverage of number of deaths. Table 2 presents the comparison number of deaths in each system. The findings show no discrepancy between two systems. In this cohort, neonates (<29 days) account for up to 35% of all deaths among children under five years old. Furthermore, among the 385 cases recorded in the A6 registry, preterm birth was identified as the cause of death in 19% of cases. Although previous studies conducted in Quang Ninh and Thai Nguyen have highlighted the underreport number of deaths in neonatal age (32). In this study, we

found that the total number of deaths does not differ, but the number of deaths in each age group varies (as seen in Table 2). Because of the significant differences in the recorded

method for causes of death between these two age groups. Therefore, we recommend standardizing and re-training the recording of death cases in community-based systems.

**Table 2. Number of deaths by sex, age, and place of residence from Certificate of Death. and A6/YTCS book**

	<b>DRS (n=384)</b>	<b>A6/YTCS (n=385)</b>
<b>Gender</b>		
Female	180 (46,9%)	173 (44,9%)
Male	204 (53,1%)	212 (55,1%)
<b>Age group</b>		
<29 days	125 (32,6%)	136 (35,3%)
29 days - <1 year	134 (34,9%)	128 (33,2%)
1 - 4 years	125 (32,6%)	121 (31,4%)
<b>District</b>		
Bac Ha	53 (13,8%)	53 (13,8%)
Bao Thang	45 (11,7%)	43 (11,2%)
Bao Yen	40 (10,4%)	40 (10,4%)
Bat Xat	52 (13,5%)	53 (13,8%)
Muong Khuong	50 (13,0%)	48 (12,5%)
Si Ma Cai	32 (8,3%)	33 (8,6%)
Van Ban	42 (10,9%)	41 (10,6%)
Lao Cai (city)	16 (4,2%)	15 (3,9%)
Sa Pa	54 (14,1%)	59 (15,3%)

In 2023, Lao Cai had an estimated population of approximately 770,6 thousand residents (17,18) ethnic minority groups contributed a large population (17,18). According to data from the Population and Housing Census 2019, the Kinh were the largest ethnic group in the province, with a population of nearly 250 thousand (9) followed by the H'Mong, comprising approximately 185 thousand individuals, the Tay (110 thousands) and Dao (105 thousands) (9). This study indicates that mortality cases of H'Mong accounted for the majority of in the province, comprising 64% of all recorded deaths in two-year 2022 and

2023. The number of deaths among children under 5-year-old in the Tay and Dao ethnic groups are higher than that of children in the Kinh ethnic group, particularly among newborns. Some studies have shown that child mortality is significantly influenced by ethnicity (4–6). Moreover, children born to women from ethnic minority groups face a higher risk of mortality compared to those born to Kinh women (4). These studies also highlighted several reasons, which are: 1) disparities in childcare practices play a critical role in these differences. For instance, a study by Tuấn et al. (2016) highlighted statistically

significant differences in breastfeeding duration and methods among the Tay, Thai, Kinh, and E-De ethnic groups (19); 2) Lao Cai is a province characterized by a complex mountainous terrain, with distinct topographical fragmentation and stratification due to the Hoang Lien Son Range, the Con Voi Range, and numerous smaller mountainous areas (17). This geographical landscape poses a significant barrier to healthcare accessibility. Given these findings, this study underscores the need for targeted interventions aimed at reducing preterm death among ethnic minority populations to improve child health outcomes for the implementation of the Decree No. 75/2015/NĐ-CP on “Mechanisms and policies for forest protection and development, in conjunction with policies for rapid and sustainable poverty reduction and support for ethnic minorities during the 2015–2020 period”.

Among children under five, deaths from the two leading causes: preterm birth complications and pneumonia. Moreover, the highest number of deaths due to infectious diseases was observed in children aged 29 days to under one year. Several factors contributing to the elevated risk of pneumonia-related mortality in children include vaccine deficiencies, immunodeficiency, malnutrition, and environmental pollution (28, 29). Specifically, observed increases in death cases for infectious diseases such as diarrheal diseases and measles among children over six months of age may be associated with the loss of maternal passive immunity (20). We suppose that these risks get particularly pronounced in remote areas such as Lao Cai province. Previous study on neonatal survival suggests that vitamin A supplementation for children over six months is a key intervention in reducing child mortality (21). Therefore, reassessing the coverage of vaccination, including the vaccine- coverage for pregnant women in Lao Cai province, is urgent.

Drowning is the most frequently reported cause of accidental death, accounting for 10% of all fatalities. While inadequate child supervision is a known risk factor, the geographical characteristics of Lao Cai province must also be considered. In this study, the number of paediatric drowning deaths was higher during the rainy season compared to the dry season (23 cases vs. 15 cases). Lao Cai frequently faces risks of flooding and landslides due to its topography and climate (23, 24). The province is characterized by mountainous terrain, large fault lines formed by rivers, and a climate influenced by storm-induced rainfall. Beyond geographic and topographical conditions, drowning mortality is also different among age. Our findings indicate that deaths from accidental injuries and drowning, were predominantly observed in children aged 1–4 years. This age group is characterized by increased physical activity and more complex daily behaviours, leading to a heightened risk of accidents. Furthermore, previous studies have reported a higher incidence of drowning fatalities among male children compared to females (25, 26). To mitigate paediatric drowning incidents, several internationally recommended preventive measures include swimming skill training for children, the elimination of unnecessary water bodies, and the installation of barriers around ponds, lakes, residential areas, and schools (27). However, implementing basic survival skill training at this young age remains challenging. Therefore, the most crucial preventive approach is raising parental awareness and supervision.

This study has several limitations. The main cause of death recorded in the A6/YTCS registry was documented in textual form at the time of death. This information was subsequently coded and cleaned by experts at the National Children’s Hospital. However, during the study period, the A6/YTCS registry in Lao Cai did not capture co-infections that could increase the risk

of mortality in children under five years of age. Therefore, future research should incorporate verbal autopsy interviews at the household level to accurately determine the sequence of events leading to death. This approach would enhance the understanding of underlying mortality patterns and support the development of targeted and effective intervention programs.

## CONCLUSION

The study findings reveal a significant number of children mortality cases in neonatal age group in Lao Cai. The leading causes of mortality among children include preterm birth, pneumonia, and drowning. The study recommends strengthening the existing community-based mortality verification process to enhance the accuracy of mortality information and strengthen health care system aimed at reducing neonatal deaths, particularly in disadvantaged regions.

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